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ABSTRACT

Three main facets have been postulated to interactively comprise the student achievement complex. These include the student's motivational make-up, study behaviors and strategies, and cognitive and self-management demands with student study activities. This investigation is a subset of a series of studies on personality correlates, study strategies, and academic achievement. As a part of a test battery, the California Psychological Inventory (CPI) and two forms of the Study Activity Survey (SAS), a self-report inventory of students' study behaviors, were administered to 220 college students. Criterion information consisted of two pools of 50- and 150-item examinations given in an introductory psychology course. These test items were coded into fact and comprehension categories and correlated with subsets of both CPI scales and SAS clusters of items. The results revealed systematic patterns of achievement orientation and type of test item. Study strategies varied non-randomly with both personality patterns and item types in the examination. Implications for refinement of techniques to identify the non-optimal student, aids in studying, and design of examinations in college social science classes are discussed. (Author/ABL)

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Relationships Between Personality Factors and Types of Test Items in a College Multiple-Choice Exam

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Abstract

This investigation is a subset of a series of studies on personality correlates, study strategies and academic achievement. As part of a test battery we administered the California Psychological Inventory (CPI) and two forms of the Study Activity Survey (Forms R and T), a self-report inventory of students' study behaviors, to 220 University of California, Berkelely students. Criterion infomation consisted of two pools of 50- and 150-item examinations given in an intoductory psychology course. These test-items were coded into fact and comprehension categories and correlated with subsets of both CPI scales and SAS clusters of items. Results revealed systematic patterns of achievement orientation and type of test-item. Study strategies varied non-randomly with both, personality patterns and item types in the examination. We discuss implications for refinement of techniques to identidy the non-optimal student, aids in studying, and design of examinations in college social science classes.

Relationships Between Personality Factors
and Types of Test Items
in a College Multiple-Choice Exam

Academic success in school is prodominantly defined in terms of grades received. Grades in turn determine in large measure students' future academic as well as occupational opportunities. It is not surprising, then, that as a result much effort is spent investigating the complex interrelationships among achievement, personality, and study process variables. The theoretical model from which the present investigation was generated (Thomas & Rohwer, in press; Rohwer & Thomas, 1985) postulates three main facets which interactively comprise the student-achievement complex.

The first facet is the student's motivational make-up, including more enduring personality characteristics and achievement styles. In the present study, special attention was focussed on independent vs. contex-bound achievement orientations, behavior-management variables like responsibility and socialization, as well as cognitive-stylistic personality characteristics such as flexibility and tolerance, among others.

The second facet consists of the study-behaviors and strategies employed by those learner who prove highly successful as well as those who are performing marginally.

With respect to activities that students engage in routinely and also in their preparation for tests, cognitive transformational strategies and self-management activities have been shown to vary reliably with achievement indicators.

Third, the cognitive and self-management demands posed by a given course environment must be analyzed in conjunction with student study activities for a comprehensive picture to emerge. Such demands include supporting materials such as assigned readings and learning aids, and of notable importance tests. With increasing educational levels reliance on tests as indicators of academic performance becomes more prevalent. In large introductory college classes, tests are often the primary if not the only indicators of students' performance; moreover, instructional resource constraints may necessitate resorting to multiple-choice exams. Our purpose here is to examine in more detail the relationships among subsets of variables generated from the facet model and performance on different kinds of multiple-choice test items.

Method.

Subjects The sample consisted of 54 male and 44 female undergraduates (N=98) enrolled in an introductory psychology class in the Spring semester of 1985 at the University of California, Berkeley.

Instruments.

The Study Activity Survey. (Forms R and T). This instrument was developed at the Autonomous Learning Center of the Far West Laboratory in San Francisco. The framework for its development comprises two factors: a) study purpose, that is, whether a given study activity is undertaken in the service of preparation for a major test (Form T) or for routine assignments daily or weekly (Form R); b) function, whether activities serve cognitive or self-management functions. The class of cognitive activities itself consists of four sub-classes of functions: selection, comprehension, memory, and integration. The class of self-management activities, in turn, consists of two sub-classes: time management and effort management.

Both forms R and T were administered to all subjects, comprising an item pool of 156 and 150, respectively. Form R is scored for 14 subscales of which 11 primarily concern cognitive activities, and three concern self-management activities. Of the 12 scales scored on form T, nine concern cognitive activities and three self-management activities. Eleven scales are represented by items on both sections of the SAS. One scale is unique to section T, while two

additional scales are unique to section R. Scales for form R and form T are listed and characterized in Table 1.

California Psychological Inventory. The CPI was administered in its entirety, yielding 18 scale scores. A subset of these--Achievement via Conformance (Ac), Achievement via Independence (Ai), Flexibility (Fx), Tolerance (To), Responsibility (Re) and Socialization (So)--were hypothesized to be of particular relevance to the present study, as well as to the general framework of which this study is a subset. Scores on the scales "Good Impression" (Gi) and Communality (Cm) were examined to gauge the validity of responses in general as well as to assess the social desirability of items on the SAS instruments.

Multiple-Choice Test. Fifty items from the second midterm and 160 items from the final exam in the psychology course were generated and coded as follows: 195 items were selected from a published test-item bank accompanying the introductory textbook used in the course (Roediger, Rushton, Capaldi, & Paris, 1984); the remaining 15 items were constructed by the instructor. Two independent judges (psychology graduate students) coded each item on the midterm and a subset of 90 items on the final into fact or comprehension categories (including all of the instructor generated items). The taxonomy underlying the coding scheme distinguishes test items on the basis of the nature and number of transformational steps the student must go through to arrive at a correct answer (Weiss & Strage, 1985). Low

cognitive demand is posed by items which require generation or recognition of identity relationships of the test-taker or, construction of examples given a rule, among others, while high cognitive demand items require the student to know and apply principles, or generate principles on the basis of given information. Hence, fact items require fewer cognitive-transformational steps than comprehension items. Inter-coder reliability was very high (Cronbach's alpha .98). Items were subsequently sorted again into fact and comprehension types, but based on the test-publisher's categorization. The correlation of this sort with the coders' ratings was very high (r = .96).

Results.

Both midterm and final exam items were scored for numbers of answers and subsequently scale scores for fact and comprehension items were computed. The latter computation was performed separately on the second midterm and the three subparts of the final exam; each of the these parts related to different substantive areas. All subscores were correlated with total scores received on the first and second midterm, final exam, SAS and CPI scales. Inspection of the correlation matrix revealed no appreciable differences among subscores within fact and comprehension sets. Consequently, these subscores within each category were pooled to yield total scores. Futhermore, the pattern of intercorrelations suggested that neither fact nor comprehension items posed differential difficulty levels as

might have been suspected. This hypothesis was further confirmed by inspecting item-difficulty levels--i.e.: the number of students passing a given item--for both types of items.

Test-item Type and Study Activities

A correlation matrix was computed including SAS scale scores, total scores on midterms 1 and 2 and the final exam, and subscores on fact and comprehension items (pooled over midterm 2 and final exam). The resulting correlation coefficients ranged from .27 to .45 ($p > .02$). As suggested by the patterns of correlations among SAS subscales and fact-comprehension scores, while some activities relate to performance on all three total test scores some are unique to either performance on fact-items while others are unique to comprehension-type items (see Table 2).

Students performing well on fact items report routinely engaging in cognitive activities involving duplicative processing. Information previously encountered is mentally recycled or re-encoded without much alteration. Moreover, when preparing for a test, they do not appear to elaborate or transform target information to enhance memorability as is denoted by scores on the SAS scale Generation of Verbatim Information; instead information is encoded verbatim or with little transformation accross mental modality. At the same time, these students characterize themselves as able and knowledgeable in dealing with challenging cognitive tasks, both in their routine as well as test-preparation study

activities; that is they are high-scorers on Self-Evaluation of Cognitive Ability.

Students who score high on comprehension-type items on the other hand, appear to elaborate, reorganize, contrast, integrate,and summarize newly encountered and previously recorded or encoded information as suggested by their high scores on the Generation of Constructed/Interpreted Information subscales for both, routine and test-preparation forms of the SAS. In preparing for an exam, however, they report engaging in duplicative processing as well. In further contrast to those who perform especially well on fact-items, these students appear to use specific procedures for managing time and effort and characterize themselves as able to and knowledgeable about how to deal effectively with challenging resource management tasks when preparing for an exam, as reflected in their scores on Means of Resource Management and Self-Evaluation of Management Ability scales on form T of the SAS (see Table 3).

Students who perform well on both types of items, thus receiving higher grades, engage routinely in Selective Notetaking and Pre-Reading Preparation; they purposefully select and record information that is difficult or substantively relevant.

Gender, Test-Item and SAS-scale Differences

The preceding analysis was conducted separately for males and females; correlations of CPI scales, SAS scale scores, fact and comprehension scores, and total scores on

the three exams, ranged from .33 to .68 ($p > .02$). For overall performance on the tests, patterns of correlations remained similar for males and females, the only notable difference being that males who did not perform well overall appeared to have difficulty managing their time during test-preparation, while reporting intense application of their energy to the task at hand (i.e.: Assiduous Resource Management) in their routine study activities. Females did not show this pattern of results. Students of both sexes who received high grades on the three exams reported engaging in Pre-Reading Preparation and Selective Notetaking in their routine study sessions (see Table 3).

Males and females appear different in their styles of approaching fact and comprehension items. Males who perform well on fact-type items appear to routinely engage in Receptive Processing, that is, they register information given in texts or by the instructor without further processing or transforming. Males who do poorly on the same items report having difficulties memorizing information while neither engaging in receptive nor integrative processing. Females who perform poorly on fact-type items report that in their test-preparation sessions they actively transform target information to enhance memory (i.e.: do not engage in Generation of Verbatim Information while engaging in Generation of Constructed Information). This would suggest that females who routinely perform such transformational activities should do better on

comprehension-type items; an hypothesis which is indeed corroborated by the patterns of correlations. Females who perform well on fact items score high on the SAS scale Assiduous Resource Management, that is, seem capable of intensly applying their energy to tasks at hand, while characterizing themselves as able and knowledgeable in dealing with challenging cognitive tasks (i.e.: they are high scorers on SAS scale Self-Evaluation of Cognitive Ability). Moreover, these students appear to manage their study times better than their classmates who are less successful not only on fact items but on exams overall.

High performance on comprehension-type items is characteristic of males who actively engage in memorability and integration efforts, whereas for females selection of information appears more pertinent. At the same time, high-scoring females appear to rely more than males on active generation of the meaning of encountered information as well as integration and summarization of newly encountered information to enhance comprehension or memory (see Table 3).

Personality Correlates of Item-Type Performance.

CPI scale scores were entered into a correlation matrix together with test performance indicators and test-item type subscales. Furthermore, multiple regression equations were constructed to predict fact and comprehension scores from combinations of CPI scales for the total sample and separately for males and females. Results are reported only

if a) the single-order correlation between a CPI scale and a test score exceeds a probability value of .02, and b) the CPI scale entered the test performance prediction equation when a stepwise entry method was used.

The CPI yields separate scores for male and female samples based on differences in the respective norm groups. It is therefor prudent as well as customary to discuss results separately for males and females. As expected, distinct patterns emerged for males and females.

For both males and females, Achievement via Independence and Social-Presence related positively to overall performance on the exams. This finding, corroborated in previous research, shows a progression from context-dependent or conforming achievement styles in lower grade levels such as junior and senior high schools to more independent achievement orientations in college courses, and especially social science courses. Successful college students are those with superior intellectual ability and judgment, who are independent and self-reliant in less structured contexts, as well as showing enthusiasm, spontaneity, and imagination in such courses.

In the female sample Achievement via Independence was the first of the CPI scales to enter the prediction equations for both fact and comprehension subscores. However, Achievement via Conformance only predicted fact items. This scale, together with Tolerance, Femininity and Sociability, accounted for 73% of the variance in fact

scores. Inspection of the correlation matrix reveals positive correlations for Achievement via Conformance, Sociability, and Tolerance but a negative correlation for Femininity scores. Females who in addition to independent achievement orientations are also capable of working in settings where conformance is a positive value, as in a more rule-constraint context, and who are seen by others as competitive, outgoing, ambitious, and direct in thinking and action, perform well on fact items.

Females who, in addition to scoring high on Ai, also score high on Social Presence and Tolerance perform better on comprehension items; the combination of these scales accounts for 65% of the variance in comprehension scores. Persons having this pattern of CPI scores can be described as imaginative, creative, clever, and ambitious, people who are capable of persistent but context-independent working styles. The slightly negative connotations of the low femininity scores evidenced in their classmates who are more comfortable with fact-type items, that is, the sometimes hard-headed, manipulative and opportunistic implications of that scale, are absent from this profile.

A similar picture with respect to comprehension items emerges for the males in the sample. Achievement via Independence, Social Presence and Femininity enter the equation, all showing a positive single-order correlation with scores on items of this type and together account for 55% of the vairance in comprehension scores. Thus, the type

of male who performs well on comprehension items may be described as a capable, self-reliant, and foresighted individual who is intelligent (and can be lazy at times) and at the same time is seen by others as appreciative and worrying.

In contrast, the type of male who performs well on fact items appears to be more self-confident, opportunistic, and enterprising. Achievement via Independence is conspicuously absent from this profile. Instead, Self-Acceptance, Femininity, and Dominance enter the equation, followed by Socialization and Responsibility. All of these scales show a positive correlation except for Femininity which correlates negatively with fact item scores. Individuals who show this profile pattern can be described as planful, persistent, as well as self-reliant and independent; yet stern and forceful in their interactions with others. At times these people might be overly self-accepting, opportunistic and egotistical, while such characteristics seem to be tempered by their high social adaptation level and sense of personal responsibility.

Study Activities and Ac/Ai Patterns

Achievement via Independence appeared to be a significant component in both fact and comprehension items, yet Achievement via Conformance appeared relevant mainly to fact-type test items. In order to further refine the study activity-achievement style description, a separate analysis was conducted, correlating Study Activity items rather than

scales, Achievement via Conformace (Ac), and Achievement via Independence (Ai) scores. SAS-items correlating significantly with either CPI scale were selected and entered into a regression model in stepwise fashion with Ac and Ai as criteria. Results from these analyses confirm differences in study- and self-management activities for conforming vs. independent achievement styles (See Tables 4 and 5).

Similarly to the results discussed above pertaining to SAS-scale scores, high scorers on Ai report more transformational activities than do high scorers on Ac; they report reading chapter summaries, reading relevant notes and study guides before reading assignments, breaking work up into chunks, as well as noticing points that are hard to understand. Furthermore, they report having no trouble sticking to tasks and do not seem to continue reading or working without paying attention. These people appear to apply strategies based on their own experience working with this kind of information while being sensitive to their own shortcomings in a realistic assessment of their capabilities (see Table 5).

High scorers on Ac on the other hand appear to be more externally driven as well as more sensitive to cues provided by the instructor (see Table 4). They report knowing how much effort is needed to do well, taking note when the instructor relates difficult points, as well as rewarding themselves for completing assignments. At the same time,

they seem to be persistent and assiduous workers, making special efforts to pick out important points, taking notes during reading assigments, as well as making a brief note to themselves when something is hard to understand.

General Discussion

These findings have a number of implications for the learning-achievement complex in general and performance on multiple-choice college examinations in particular. First, with respect to test-items commonly employed in this examination situation, fact-type items appear to be much more common than comprehension items. About seventy percent of the items contained in the test bank utilized in this study were of the fact type. While it is probably the intention of every good instructor to promote students' understanding of principles and concepts which could be applied to newly encountered contexts, tests actually used to assess deeper understanding of the subject matter may not do justice to this objective. Care should be taken to construct items which represent both item types with similar frequency.

Second, students of equal intellectual prowess but with different studying styles and different approaches to cognitive activities as well as self-management abilities may nevertheless perform quite differently in their course work. High ability students who engage in deeper levels of processing, transform information accross modalities,

actively integrate new information, and inquire into the meaning of concepts and information may be penalized by virtue of the fact that examinations consist of a minority of the kinds of test items that would allow them to exhibit their knowledge adequately; unless these students also note that good performance on these kinds of tests mainly requires receptive and duplicative processing. Students who are more context-bound achievers, who study more for the purpose of doing well on an exam, and engage in more rote-type cognitive activities may be assessed as of equal if not superior performance than those who engage in deeper kinds of processing.

Third, it may be of benefit to both instructors and researchers to be aware of the fact that such enduring personality characteristics as flexibility, tolerance, socialization, and responsibiliy, over and above styles of conforming or independent achievement, contribute significantly to students' performance in college. The successful learner is not characterized by intellectual aptitude alone, a fact of importance for instructors and researchers alike.

Finally, it remains to be investigated to what degree these differential studying approaches and enduring motivational characteristics relate to post-college outcome criteria such as occupational performance. Only then will it be possible to establish the relative long-term values of deeper in contrast to more shallow processing approaches.

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Table 1

Study Activity Survey Cluster Names

and Characterizations

Form-R	Form-T	
1	-	Uniform Processing -- Non-selective processing of all the information at hand, voluntary, intensly, or earnestly
2	2	Assiduous Resource Management -- Voluntary, intense, or earnest preparation of or application of one's energy to the task or activity at hand
3	3	Cognitive Monitoring -- Active checking of one's own state of comprehension or memory for information
4	4	Duplicative Processing -- Unaltered re-encoding or mental recycling of previously encountered information
5	5	Focus on Test Relevance -- Self-initiated investigation, identification, and allocation of processing of information that is likely to be important for a test
6	6	Generation of Constructed Information -- Elaborating, reorganizing, contrasting, integrating, or summarizing newly encountered, previously recorded or encoded information
7	7	Generation of Interpreted Information -- Explicating, investigating, or inquiring into the meaning of target information to enhance comprehension or memory
8	-	Hyperprocessing -- Self-initiation of extra processing of information that is anticipated to present comprehension or memory difficulties
-	8	Generation of Verbatim Information -- Elaborating or transforming mental modality of target information to enhance memorability

Table 1 contd.:

9	9	Means of Resource Management -- Using specific procedures for managing time and effort in contrast to worrying about managing them
10	-	Pre-Reading Preparation -- Planning for selection prior to reading
11	-	Receptive Processing -- Reception of information given in texts or by instructor without implication of further processing
12	10	Selective Notetaking -- Purposeful recording of information selected on criteria of difficulty or substantive relevance
13	11	Self-Evaluation of Cognitive Ability -- Characterizes self as able and knowledgeable in dealing with challenging cognitive tasks
14	12	Self-Evaluation of Management Ability -- Characterizes self as able to and knowledgeable about how to deal effectively with challenging resource management tasks

Table 2

Study Activities Related to Test-Item Type

and Final Score on three Tests

for Both Males and Females

	Fact Items	Comprehension Items
Routine:		Routine and Test-Preparation:
	Duplicative Processing	Generation of Constructed Information
	Self-Evaluation of Cognitive Ability	Generation of Interpreted Information
Test-Preparation:		Test-Preparation:
	Generation of Verbatim Information	Duplicative Processing
	Self-Evaluation of Cognitive Ability	Means of Resource Management
		Self-Evaluation of Management Ability
		Time Management
		Effort Management

Final Score on Three Tests

Routine:	Selective Notetaking
	Pre-Reading Preparation

Table 3

Male-Female Differences on Study Activities
Related to Test Item Type
and Final Score on three Tests

MALES

	Fact Items		Comprehension Items
R	Receptive Processing (+)	R	Memorability (+)
R	Memorability (-)	R	Integration (+)
R	Integration (-)		

Final Score on Three Tests

T	Time-Management (-)
R	Assiduous Resource Management
R	Pre-Reading Preparation (+)
R	Selective Notetaking (+)

FEMALES

	Fact Items		Comprehension Items
T	Generation of Verbatim Information (+)	R	Generation of Constructed Information (+)
T	Generation in Constructed Information (-)	R	Selection (+)
R	Assiduous Resource Management (+)	T	Generation of Interpreted Information (+)

Table 3 contd.:

FEMALES

R	Self-Evaluation of Cognitive Ability (+)
T/R	Time-Management (+)

Final Score on Three Tests

R	Pre-Reading Preparation (+)
R	Selective Notetaking (+)

Note: 1) R and T refer to SAS Forms R-Routine and T-Test-Preparation

2) (+) and (-) signs refer to direction of correlation in single-order correlation matrix

Table 4

Study Activity Survey items predicting

Achievement via Conformance

Item #	
8	When working outside of class, I know how much effort is needed to do well
10	When working outside of class, I make a special effort to pick out the important points
22	Before I begin a reading assignment, I find out from the instructor what to focus on
27	When doing the assigned reading for this course, I take notes
66	When doing the out-of-class work for this course, I have trouble getting started when I sid down to do the work
74	To make sure I get my out-of-class work done, I reward myself for completing assignments
78	When doing the out-of-class work for this course, I work until I finish the assignments
108	During class meetings, I take notes when the instructor emphasizes a point
119	When something presented in class is hard to understand, I make a brief note of it
133	During class meetings, I make a note when the instructor relates different points to one another

Note: R (for all predictors) = .88, $p > .001$

R (squared) = .77

Table 5

Study Activity Survey Items Predicting

Achievement via Independence

Item-#	
2	When working outside of class, as points come up I notice the ones I don't understand
23	Before I begin a reading assignment, I read chapter summaries
24	Before I begin a reading assignment, I review relevant notes and study guides
42	When I come across something in the assigned reading that is hard to understand, I try to figure it out from the context
56	When doing the day-to-day work for this course outside of class, I make a mental picture to represent important ideas
67	When doing the out-of-class work for this course, I have trouble concentrating
82	When doing the out-of-class work for this course, I have trouble following a time plan or schedule
83	When doing the out-of-class work for this course, I break up the work I need to do into chunks
93	During class meetings, I notice when some facts or ideas can be related to other facts or ideas

Note: R (for all predictors) = .66 ($p > .001$)

R (squared) = .44